

LISTING OF THE CLAIMS

1. (Previously Presented) A network node apparatus included in a plurality of node apparatuses connected via a transmission line, including a start node apparatus, and end node apparatus, and a center node apparatus, each node apparatus having an input terminal and an output terminal being each connected to said transmission line to form a bi-directional transmission path via said transmission line to another network node apparatus, comprising:

a switching device for switching a signal sent out via said transmission path from said another network node apparatus to be folded back and output to said another network node apparatus again;

a test signal sending component for sending out a test signal into said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, whereby the test signal is sent from each of the start node apparatus and the end node apparatus of said transmission line to a center node apparatus; and

a determination device for determining the signal quality of the test signal by receiving the folded-back test signal,

whereby when said switching device is included in the center node apparatus and switches the test signal sent out via said transmission path from each of said start node apparatus and said end node apparatus to be folded back and output to each of said start node apparatus and said end node apparatus again, and whereby each of said start node and said end node having received the folded-back signal identifies a fault location based on the determination result from the determination

device; and releases the nodes outside a fault interval in said transmission path, if there is any fault detected in either said start node or said end node during the identification operation.

2. (Original) The network node apparatus according to claim 1, further comprising: means for demultiplexing a wavelength multiplexed signal entered from said transmission line; and means for multiplexing the wavelength demultiplexed signal again by exchanging said wavelength demultiplexed signal into a predetermined route.

3. (Original) The network node apparatus according to claim 2, further comprising wavelength conversion means for converting the wavelength of the signal sent out from said another network node apparatus into the wavelength of said wavelength demultiplexed signal.

4. (Cancelled)

5. (Original) The network node apparatus according to claim 3, further comprising a test signal sending component for sending out a test signal into said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, wherein said switching means switches the test signal sent out via said transmission path from said another network node apparatus to be folded back and output to said another network node apparatus again, and said wavelength conversion means converts the wavelength of the test signal into the wavelength of signal on said transmission line where the fault has occurred.

6. (Cancelled)

7. (Previously Presented) The network node apparatus according to claim 1, wherein said determination means comprises a test signal receiving component for receiving the test signal, and a determination portion for determining the presence or absence of the fault by comparing the signal quality of the test signal received by said test signal receiving component with a predetermined value.

8. (Previously Presented) The network node apparatus according to claim 1, wherein said test signal sending component notifies the determination result of said determination means to said another network node apparatus.

9. (Original) The network node apparatus according to claim 8, wherein said test signal sending component transmits the test signal after notifying said determination result.

10. (Previously Presented) The network node apparatus according to claim 1, wherein said determination means measures at least one of BER (Bit Error Rate), S (Signal)/N (Noise) ratio, the power of the test signal, and the wavelength of the test signal as said signal quality.

11. (Original) The network node apparatus according to claim 1, wherein the transparent transmission is performed.

12. (Previously Presented) A network system comprising a plurality of network node apparatuses connected via a transmission line, including a start node apparatus, and end node apparatus, and a center node apparatus, each network node apparatus having an input terminal and an output terminal being each connected to said transmission line to form a bi-directional transmission path via said transmission line to another network node apparatus, wherein said network system comprises:

a test signal sending component for sending out a test signal into said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, whereby the test signal is sent from each of the start node apparatus and the end node apparatus of said transmission line to a center node apparatus;

a switching device for switching a signal sent out via said transmission path from said another network node apparatus to be folded back and output to said another network node apparatus again, wherein said switching means in the center node apparatus switches the test signal sent out via said transmission path from each of said start node apparatus and said end node apparatus to be folded back and output to each of said start node apparatus and said end node apparatus again;

determination means for determining the signal quality of the test signal by receiving the test signal at each of the start node apparatus and the end node apparatus,

whereby each of said start node and said end node having received the determination result identifies a fault location based on the determination result; and releases the nodes outside a fault interval in said transmission path, if there is any fault detected in either said start node or said end node during the identification operation.

13. (Original) The network system according to claim 12, wherein said network node apparatus comprises means for demultiplexing a wavelength multiplexed signal entered from said transmission line, and means for multiplexing the wavelength demultiplexed signal again by exchanging said wavelength demultiplexed signal into a predetermined route.

14. (Original) The network system according to claim 13, wherein said network node apparatus further comprises wavelength conversion means for converting the wavelength of the signal sent out from said another network node apparatus into the wavelength of the wavelength demultiplexed signal.

15. (Cancelled)

16. (Original) The network system according to claim 14, wherein said network node apparatus further comprises a test signal sending component for sending out a test signal to said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, wherein said switching means switches the test signal sent out via said transmission path from said another network node apparatus to be folded back and output to said another network node apparatus again, and said wavelength conversion means converts the wavelength of the test signal into the wavelength of signal on said transmission line where the fault has occurred.

17. (Previously Presented) The network system according to claim 12, wherein said network node apparatus further comprises determination means for determining the signal quality of the test signal by receiving the test signal to effect transmission control over said test signal sending component in accordance with the determination result.

18. (Original) The network system according to claim 17, wherein said determination means comprises a test signal receiving component for receiving the test signal, and a determination portion for determining the presence or absence of the fault by comparing the signal quality of the test signal received by said test signal receiving component with a predetermined value.

19. (Original) The network system according to claim 17, wherein said test signal sending component notifies the determination result of said determination means to said another network node apparatus.

20. (Original) The network system according to claim 19, wherein said test signal sending component sends out the test signal after notifying said determination result.

21. (Original) The network system according to claim 17, wherein said determination means measures at least one of BER, S/N ratio, the power of the test signal, and the wavelength of the test signal as said signal quality.

22. (Original) The network system according to claim 12, wherein said network node apparatus makes the transparent transmission.

23. (Previously Presented) A fault location detecting method for use in a network system having a plurality of network nodes (hereinafter referred to as nodes) connected via a transmission line, comprising steps for: sending out a test signal from a terminal node of said transmission line to a working system path (current path) after switching said working system path to an auxiliary system path (stand-by path) in response to occurrence of a fault; folding back the test signal to said terminal node in a node that has received the test signal; and determining the signal quality of the test signal folded back to identify the fault location based on the determination result in said terminal node, wherein said terminal node is each of a start node and an end node of said transmission line.

24. (Cancelled)

25. (Previously Presented) A fault location detecting method for use in a network system having a plurality of nodes connected via a transmission line, the method comprising:

 sending out a test signal from a terminal node of said transmission line to a working system path (current path) after switching said working system path to an auxiliary system path (stand-by path) in response to occurrence of a fault;

 sending out the determination result to said terminal node by determining the signal quality of the test signal in a node that has received the test signal;

 identifying the fault location based on the determination result in said terminal node that has received the determination result; and

 sending out the test signal from the node having sent out the determination result to said working system path if there is no fault detected during the operation of the identifying step.

26. (Previously Presented) The fault location detecting method according to claim 25, further comprising: extending the node for sending out the test signal by every one hop in succession from the node having sent out said determination result.

27. (Cancelled)

28. (Previously Presented) A fault location detecting method for use in a network system having a plurality of nodes connected via a transmission line, the method comprising:

sending out a test signal from each of a start node and an end node of said transmission line to a node located in the center of a working system path (current path) after switching said working system path to an auxiliary system path (stand-by path) in response to occurrence of a fault;

folding back the test signal to each of said start node and said end node in the node located in the center of said working system path that has received the test signal;

identifying the fault location based on the determination result by determining the signal quality of the test signal folded back at each of said start node and said end node; and

releasing the nodes outside a fault interval in said working system path, if there is any fault detected in either said start node or said end node during the operation of the identifying step.

29. (Previously Presented) A fault location detecting method for use in a network system having a plurality of nodes connected via a transmission line, the method comprising:

sending out a test signal from each of a start node and an end node of said transmission line to a node located in the center of a working system path (current path) after switching said working system path to an auxiliary system path (stand-by path) in response to occurrence of a fault;

sending out the determination result to each of said start node and said end node by determining the signal quality of the test signal in the node located in the center of said working system path that has received the test signal;

identifying a fault location based on the determination result at each of said start node and said end node having received the determination result; and

releasing the nodes outside a fault interval in said working system path to set up the other path, if there is any fault detected in either said start node or said end node during the operation of the identifying step.

30. (Previously Presented) The fault location detecting method according to claim 23, further comprising folding back a wavelength signal to said terminal node after converting the wavelength of the test signal into the wavelength signal on said transmission line where the fault has occurred in the node having received the test signal.

31. (Cancelled)

32. (Previously Presented) The fault location detecting method according to claim 23, further comprising extending the node for folding back the test signal by every one hop in succession from said terminal node.

33. (Previously Presented) The fault location detecting method according to claim 23, further comprising:

extending the node for folding back the test signal by every plural hops in succession from said terminal node;

and reducing the number of hops for extending the node in the fault interval, if there is any fault detected during the extending operation.

34. (Previously Presented) The fault location detecting method according to claim 23, further comprising:

extending the node for folding back the test signal by every one hop in succession from said terminal node;

and folding back the test signal via the nodes outside said working system path, if there is any fault detected during the extending operation.

35. (Original) The fault location detecting method according to claim 23, wherein the signal quality of the test signal is determining by measuring at least one of BER, S/N ratio, the power of the test signal and the wavelength of the test signal.

36. (Previously Presented) A network node apparatus having an input terminal and an output terminal being each connected to a transmission line, which forms a bi-directional transmission path via said transmission line to another network node apparatus, comprising:

a determination device in said network node for determining the signal quality of a received test signal from another network node sent into said transmission path in response to occurrence of a fault;

a test signal sending component in said network node apparatus for sending out a test signal into said transmission path;

wherein said test signal sending component notifies the determination result of said determination device to said another network node apparatus and, if no fault is identified, transmits the test signal to a next network node apparatus after notifying said determination result.

37. (Previously Presented) The network node apparatus according to claim 36, wherein said determination device comprises a test signal receiving component for receiving the test signal, and a determination portion for determining the presence or absence of the fault by comparing the signal quality of the test signal received by said test signal receiving component with a predetermined value.

38. (Previously Presented) The network node apparatus according to claim 36, wherein said determination device measures at least one of BER (Bit Error Rate), S (Signal)/N (Noise) ratio, the power of the test signal, and the wavelength of the first test signal as said signal quality.

39. (Previously Presented) The network apparatus according to claim 36, wherein said network node apparatus further comprises determination means for determining the signal quality of the test signal by receiving the test signal to effect transmission control over said test signal sending component in accordance with the determination result.

40. (Previously Presented) A network system comprising a network node apparatus having an input terminal and an output terminal being each connected to a transmission line, which forms a bi-directional transmission path via said transmission line to another network node apparatus, comprising:

a determination device in said network node for determining the signal quality of a received test signal from another network node sent into said transmission path in response to occurrence of a fault;

a test signal sending component in said network node apparatus for sending out a test signal into said transmission path;

wherein said test signal sending component notifies the determination result of said determination device to said another network node apparatus and, if no fault is identified, transmits the test signal to a next network node apparatus after notifying said determination result.

41. (Previously Presented) The network node system according to claim 40, wherein said determination means comprises a test signal receiving component for receiving the test signal, and a determination portion for determining the presence or absence of the fault by comparing the signal quality of the test signal received by said test signal receiving component with a predetermined value.

42. (Previously Presented) The network system according to claim 40, wherein said network node apparatus further comprises determination means for determining the signal quality of the test signal by receiving the test signal to effect transmission control over said test signal sending component in accordance with the determination result.

43. (Previously Presented) The network node system according to claim 40, wherein said determination means measures at least one of BER (Bit Error Rate), S (Signal)/N (Noise) ratio, the power of the test signal, and the wavelength of the first test signal as said signal quality.

44. (Previously Presented) The network node system according to claim 40, wherein said determination device comprises a test signal receiving component for receiving the test signal, and a determination portion for determining the presence or absence of the fault by comparing the signal quality of the test signal received by said test signal receiving component with a predetermined value.

45 (Previously Presented). A network node apparatus included in a plurality of node apparatuses connected via a transmission line, including a start node apparatus, and end node apparatus, and a center node apparatus, each node apparatus having an input terminal and an output terminal being each connected to said transmission line to form a bi-directional transmission path via said transmission line to another network node apparatus, wherein said network node apparatus comprises:

a test signal sending component for sending out a test signal into said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, wherein the test signal is sent from each of the start node apparatus and the end node apparatus of said transmission line to a center node apparatus;

a determination device for determining the signal quality of the test signal by receiving the test signal at the center node apparatus, whereby the center node apparatus sends the determination result to start node apparatus and the end node apparatus

whereby each of said start node and said end node having received the determination result identifies a fault location based on the determination result; and releases the nodes outside a fault interval in said transmission path, if there is any fault detected in either said start node or said end node during the identification operation.

46. (Previously Presented) A network system comprising a plurality of network node apparatuses connected via a transmission line, including a start node apparatus, and end node apparatus, and a center node apparatus, each network node apparatus having an input terminal and an output terminal being each connected to said transmission line to form a bi-directional transmission path via said transmission

line to another network node apparatus, wherein said network node apparatus comprises:

a test signal sending component for sending out a test signal into said transmission path in response to occurrence of a fault in said transmission line or said another network node apparatus, wherein the test signal is sent from each of the start node apparatus and the end node apparatus of said transmission line to a center node apparatus; and

a determination device for determining the signal quality of the test signal by receiving the test signal at the center node apparatus, whereby the center node apparatus sends the determination result to start node apparatus and the end node apparatus;

wherein each of said start node and said end node having received the determination result identifies a fault location based on the determination result; and releases the nodes outside a fault interval in said transmission path, if there is any fault detected in either said start node or said end node during the identification operation.